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Monsanto Addendum A

May 20, 1983

Incident Investigation
Department 233

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SUMMARY

Date of Incident:	April 29, 1983
Type of Incident:	Approximately 12:45 p.m.
Location:	Department 233 sewer outflow
Type of Incident:	Hot sewers
Most Probable Causes:	Inadequate separation in sewer pit due to mixing of benzene and MCB.

Investigating Committee

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CER 089438

INCIDENT

Hot sewers (vapor measured within 10% of the Lower Explosive Level (L.E.L.) were detected downstream of Department 233 (Monochlorobenzene).

BACKGROUND

In past years, the MCB department had been a significant contributor to a series of flammable organic fires and explosions which occurred in the plant sewers. CEA 3322 - MCB Benzene Reduction - addressed this problem by providing new facilities to remove free organics from waste water leaving the department. The waste water facilities contain three major pieces of equipment: Collection Pit - Item 182, Heavy Layer Pump Tank - Item 190, and the Collection Tank - Item 187.

The purpose of the Collection Pit is to collect, contain, and gravity separate all process fluids draining from the MCB and Muriatic Acid (Department 218) operating facilities. The pit is made up of three compartments (Figure 1). The first compartment collects flows from the process drain system including the benzene contaminated streams coming off the benzene - water separator drain leg and vent scrubber. The organic waste streams entering the first compartment are routinely pumped to the Collection Tank for further separation. This first compartment overflows into the intermediate compartment of the Collection Pit during high flow rates.

The intermediate compartment receives the flows from the area drains and Department 218. Under normal conditions, these flows are relatively low, and the entire stream overflows to the third compartment where it is separated and pumped to items 190 and 187. However, a high load condition can occur when Department 218 is drowning acid, or with a heavy rain or large spill. Under this condition the pit pumps can't keep up with flow and the levels in the intermediate and third compartments rise until the heavier water phase begins underflowing to the plant sewer (Figure 2).

The third compartment of the Collection Pit separates the overflow from the intermediate compartment into a light and heavy layer. The compartment is level controlled by pumping out the heavy layer (containing mostly water, but some MCB) to the Heavy Layer Pump Tank (Item 190). The light benzene layer is continuously pumped to the Collection Tank (Item 187). As previously mentioned, during periods of high loading, the pumps become overloaded and the water phase underflows out from the intermediate compartment.

The second piece of equipment of the waste water facilities is the Heavy Layer Pump Tank (Item 190). Most of the collected waste water is pumped to this vessel from the Collection Pit. Heavy layer organics (MCB's) are retained in the bottom dish

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and transferred intermittently to the Collection Tank. The water phase from Item 190 overflows continuously to the plant sewer. This is the second point at which aqueous wastes can exit the process area. A nuclear density meter installed in the overflow is designed to alarm when a heavy layer is detected and divert the stream back to the process sewer.

The third piece of equipment is the Collection Tank (Item 187) (see Figure 1). The vessel receives waste streams pumped from the first and third compartments of the Collection Pit. This vessel is designed to separate the light and heavy layer organics from the aqueous phase. The light layer organics overflow continuously to the Overflow Receiver for recycling into the process. The heavy layer is retained in the bottom of the tank for further processing. The aqueous layer flows continuously to the plant sewer. This is the third and final point at which wastes enter the plant sewer. A nuclear density meter also monitors this flow. On a high or low density reading the stream is diverted to the process sewer.

DESCRIPTION OF INCIDENT

The MCB department had started up at 7:30 p.m. on April 28. The department was coming off its spring turnaround and problems developed with the chilled MCB (mono) refrigeration system. The system, which supplies coolant to the HCl off gas coolers, could not be started up due to a chilled mono pump seal failure and leaking block valves. The decision was made to continue running until repairs could be made in the morning.

With the refrigeration system down, the benzene and MCB could not be adequately condensed out of the HCl gas stream. As per standard procedure, the contaminated gas was diverted to the HCl drowning jet system, which scrubbed the gas to the sewer. The department continued to operate in this manner throughout the night and up until the time of the incident.

The next morning, activities to change out the chilled mono pump began. Due to the leaking block valves, the first step was to drain the MCB coolant from the system. At 8:00 a.m., the MCB from the high stage cooler and associated surge tank was drained to the process sewer system.

At approximately 10:30 a.m., a dichlor odor was detected coming out of box 33-B, located downstream of Department 233 (Figure 3). A gas tester analyzed the vapor at 40% L.E.L. (a continuous sewer analyzer with alarm is located in the Department 233 control room. However, it failed to indicate any flammables.) A department survey was quickly instituted to determine the source of the organics in the sewer. No organics were seen in the underflow from the Collection Pit. However, a heavy organic layer was found in the discharge stream off the Collection Tank (Item 187). The nuclear density

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meter had failed to detect the heavy layer and thus the stream was continuing to flow to the plant sewer. At 10:40 a.m., the stream was manually diverted to the process sewer, which flowed to the Collection Pit. By 11:15 a.m., box 33-B had cooled to 10% L.E.L.

At approximately 12:30 p.m., Department 221 called Department 233 to report a hot sewer next to their railroad tracks. The sewer registered 90% L.E.L. Department 233 personnel began another survey and discovered a layer of light organics exiting with the aqueous phase from the Collection Pit (as the refrigeration system was still down, HCl off gas stream was still being drowned). At 12:57 p.m., the fire whistle was sounded and a sewer emergency was declared.

The reason for the sewer contamination was not readily apparent. However, it was known that organics were continuing to be fed to the collection pit via the Department 218 drowning jet. In order to stop this flow, preparations for the shut down of the cell house/MCB flow train began at 1:15 p.m. At 1:40 p.m., the MCB chlorinators were shut down. By 2:37 p.m., the flammability at sewer box 33-B had dropped from over 100% to 10% of the L.E.L. At 2:55 p.m., the level had dropped to 5% and the all clear was signaled.

FINDINGS

1. This is the first flammable sewer incident that has originated from Department 233 since the new sewer system installation was completed in February 1982. By comparison, there were seven sewer incidents attributed to Department 233 in 1981 and 12 incidents in 1980.

2. Approximately 500 gallons of MCB were drained from the chilled mono system into the process sewer. This was enough to overload the retention capacity of the Collection Tank (Item 187) causing the first incident. (Item 187 already contained MCB collected from the turnaround clean out.)

3. The nuclear density gauge installed on the water underflow of Tank 187 did not detect the MCB flowing with the water. The organic phase was not of sufficient quantity to change the fluid density enough to activate the interlock. This is the second time that the interlock system has failed to detect and divert organics.

4. It is estimated that 2-4 gpm of benzene and MCB were being entrained with the HCl off gas while the refrigeration system was down. This organic load to the sump collection system is semi-routine, since it occurs whenever there are problems with the HCl cooler/refrigeration system.

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5. The intermediate compartment contained a bottom layer of carbon and gravel varying between one to two feet deep. This layer reduced the retention time in the compartment by 30%.

6. No organics were detected leaving the collection pit during the first incident. A sample of the light organic layer in the pit was taken shortly after the second incident. The organic layer had a specific gravity of 0.966. An in-department GC analysis gave a composition of 55% benzene, and 43% MCB.

7. There is no sight glass or other means to detect the level of the heavy layer in tank 187.

8. It rained the morning of the incident. This contributed to the collection pit loading.

DISCUSSION

The Department 233 waste water facilities are designed to remove organics from the aqueous phase via gravity separation. The lighter than water benzene level floats to the top and is recycled back to the process. The heavier than water MCB layer settles to the bottom of the collection vessels and is either recycled or drummed off. The water layer, relatively free of organics, is allowed to flow into the plant sewer. At the time of the incident, it appears that a series of events led to the creation of a neutral buoyancy organic layer which flowed out the collection pit with the aqueous layer.

In order to create a neutral buoyancy layer, three conditions must be met: 1) benzene present in sufficient quantity; 2) MCB present in sufficient quantity; and 3) a mechanism available to mix the two chemicals. All three of these conditions were met during this incident:

1. Benzene had been present in the sewer system since starting the night before. It was contained in the HCl off gas being scrubbed by the drowning jets. The benzene had been separating from the water layer efficiently all through the night, as no benzene was originally detected in the water underflow.

2) MCB entered the sewer system when the high stage cooler and the surge tank were drained that morning. However, this did not present any immediate problem since the benzene and MCB flows remained separated. The benzene flowed into the intermediate compartment, where it separated from the water phase and overflowed into the third compartment. The MCB drained into the first compartment, where it was pumped to the collection tank (see Figure 4).

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3. The third condition, mixing, was met when the MCB filled the collection tank and began overflowing through the water outlet to the plant sewer. To prevent the MCB from entering the plant sewer, it was diverted to the process sewer, where it flowed to the first compartment of the collection pit. However, this compartment was already full of MCB. With the addition of the recycle flow, the MCB rich phase overflowed to the intermediate compartment, where it mixed with the benzene from the drowning jets. The buoyancy mixture that was produced underflowed out the compartment with the aqueous phase (see Figure 5).

The presence of a layer of solids in the bottom of the intermediate compartment probably worsened the condition to a degree. However, it is felt that organics would have flowed to the plant sewer even if the compartment had been clean.

The nuclear density meter failed to detect MCB coming from the separation tank and divert the stream to the process sewer. However, if the interlock had functioned as designed, the MCB would have been automatically fed to and mixed with the benzene in the pit. The purpose and function of this interlock needs to be reevaluated.

RECOMMENDATIONS

1. Revise the operating procedure to not knowingly drop heavies (MCB) to the sewer when there is a high benzene load to the sewer. MCB may be dropped if it can be determined there is enough room in the collection tank to hold the drop. Communicate this procedure to all associated production personnel.

   Responsibility: Production
   Timing: Complete

2. Provide a sight glass on the collection tank 187 to monitor the heavy layer level.

   Responsibility: TSD
   Timing: Design package by July 15, 1983

3. Clean the solids out of the intermediate compartment. Begin routine visual inspection to develop adequate clean out frequency.

   Responsibility: Production
   Timing: Clean out complete. Clean out schedule developed by August 1, 1983.

4. Reevaluate interlock system on collection tank and heavy layer pump tank.

   Responsibility: TSD
   Timing: Evaluation complete by September 1, 1983.

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5. Evaluate alternate methods of recycling the heavy organic layer back into the process.

Responsibility: TSD
Timing: Evaluation complete by September 1, 1983.

6. Review and reevaluate the need for and reliability of the continuous sewer analyzer.

Responsibility: TSD/Anal. Instr. Group
Timing: Recommendation by August 1, 1983

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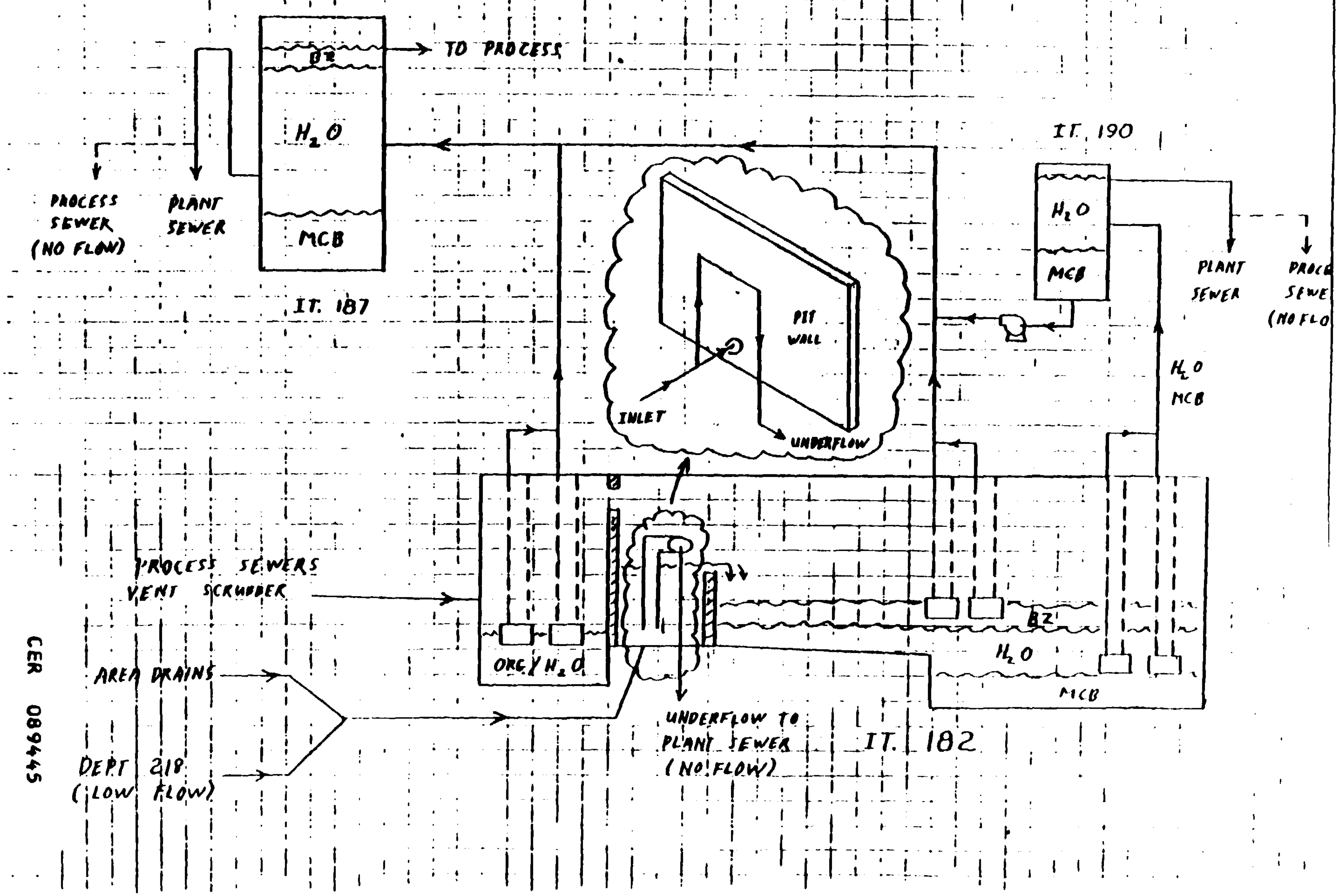
FIG 1 DEPT 2 3 SEWER COLLECTION SYST

NORMAL OPERATION



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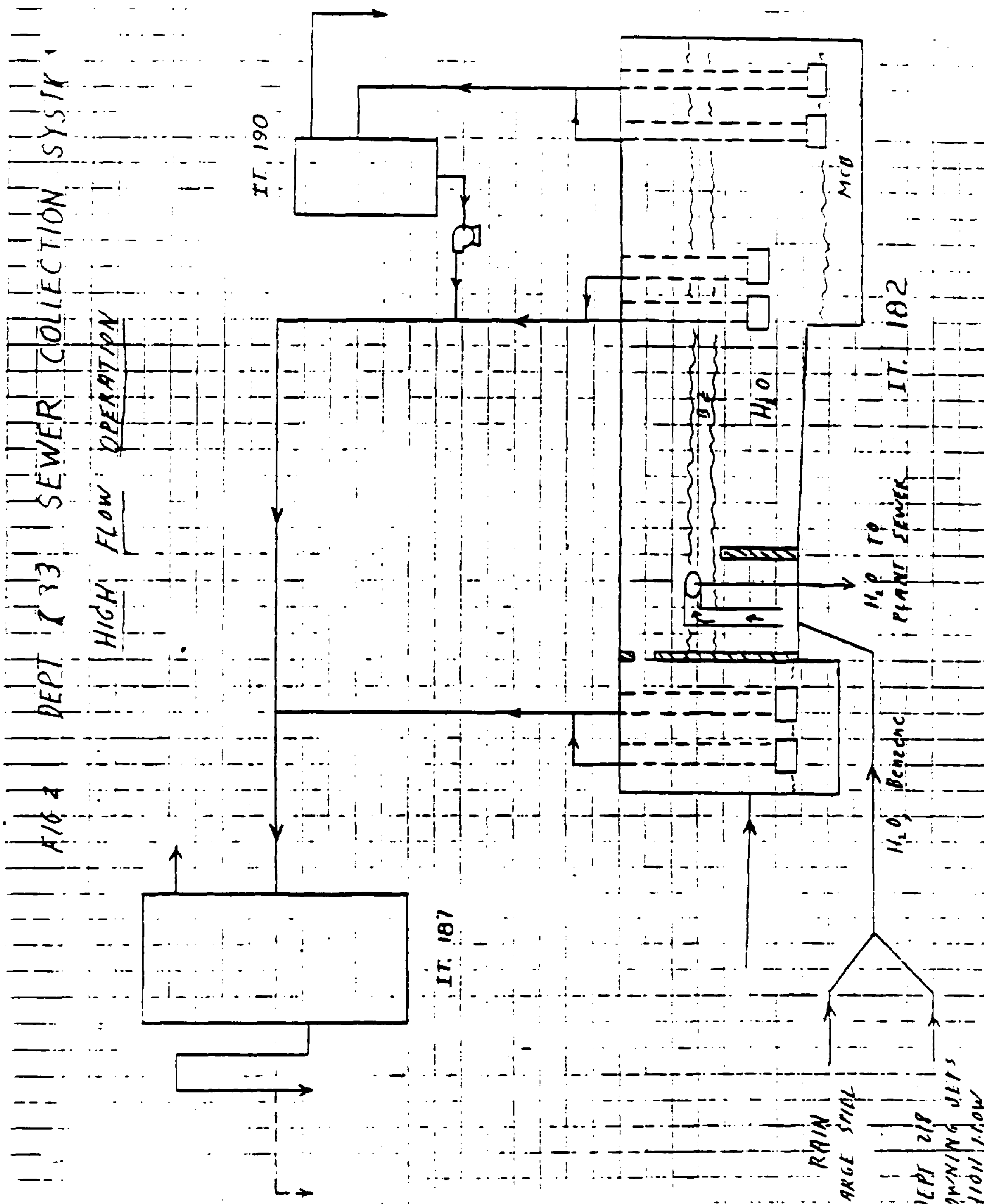
FIG 2 DEPT 233 SEWER COLLECTION SYSTEM
HIGH FLOW OPERATION
IT. 190
IT. 182
IT. 187
MCB
H_2O
H_2O TO PLANT SEWER
H_2O, Benzene
RAIN
LARGE SPILL
DEPT 218
DROWNING JETS
HIGH FLOW

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